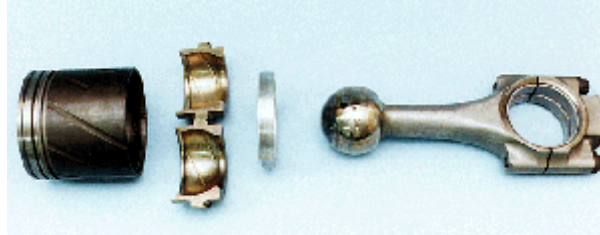


Spherical Joint Piston and Connecting Rod Developed



Spherical joint piston and connecting rod--exploded assembly.

Under an interagency agreement with the Department of Energy, the NASA Lewis Research Center manages a Heavy-Duty Diesel Engine Technology (HDET) research program. The overall program objectives are to reduce fuel consumption through increased engine efficiency, reduce engine exhaust emissions, and provide options for the use of alternative fuels. The program is administered with a balance of research contracts, university research grants, and focused in-house research.

The Cummins Engine Company participates in the HDET program under a cost-sharing research contract. Cummins is researching and developing in-cylinder component technologies for heavy-duty diesel engines. An objective of the Cummins research is to develop technologies for a low-emissions, 55-percent thermal efficiency (LE-55) engine. The best current-production engines in this class achieve about 46-percent thermal efficiency. Federal emissions regulations are driving this technology. Regulations for heavy-duty diesel engines were tightened in 1994, more demanding emissions regulations are scheduled for 1998, and another step is planned for 2002. The LE-55 engine emissions goal is set at half of the 1998 regulation level and is consistent with plans for 2002 emissions regulations.

LE-55 engine design requirements to meet the efficiency target dictate a need to operate at higher peak cylinder pressures. A key technology being developed and evaluated under the Cummins Engine Company LE-55 engine concept is the spherical joint piston and connecting rod. Unlike conventional piston and connecting rod arrangements which are joined by a pin forming a hinged joint, the spherical joint piston and connecting rod use a ball-and-socket joint. The ball-and-socket arrangement enables the piston to have an axisymmetric design allowing rotation within the cylinder. The potential benefits of piston symmetry and rotation are reduced scuffing, improved piston ring sealing, improved lubrication, mechanical and thermal load symmetry, reduced bearing stresses, reduced running clearances, and reduced oil consumption.

The spherical joint piston is a monolithic, squeeze-cast, fiber-reinforced aluminum piston. The connecting rod has a ball end that seats on a spherical saddle within the piston and is retained by a pair of aluminum bronze holder rings. The holder rings are secured by a threaded ring that mates with the piston.

As part of the ongoing research and development activity, the Cummins Engine Company successfully completed a 100-hr test of the spherical joint piston and connecting rod at LE-55 peak steady-state engine conditions. In addition, a 100-hr transient cycle test that varied engine conditions between LE-55 no-load and LE-55 full-load was successfully completed.